4 SATELLITE, WIRELESS, AND OTHER BROADBAND SOLUTIONS FOR RURAL AMERICA

Satellites and terrestrial wireless technologies offer the potential to eliminate the ultimate barrier to ubiquitous broadband connectivity for rural America — the need for a physical wire or cable transmission media to connect customers to the nation's telecommunications network. For the first time, rural, insular and other remote areas can obtain the same level and quality of access to the Internet as is available to communities that do not otherwise confront the often substantial costs associated with landline network connectivity. For such areas, not only must the wire lines themselves be long, the often extremely low population density has often made it difficult to spread the high costs of the wireline facilities among more than a small number of individuals. All of this is in the process of changing as a result of large-scale and multifaceted investment in broadband satellite and fixed wireless access to the Internet.

Satellite delivery of broadband services

Satellite-based Internet services may be particularly beneficial in rural areas, offering customers high-speed downloads while relying upon conventional (and universally available) analog telephone lines for the uplink channel, for which high data rates are usually not required. The use of satellite-based services does, for the present, mean that customers must use their existing telephone line for the uplink channel; within just a few years, however, satellite-based broadband uplinks are expected to become available, placing this serving arrangement squarely in competition with ADSL and cable-based high-speed Internet access. Once launched, satellites have the ability to provide service over an extremely large footprint, and can certainly offer a reasonably cost-effective solution until one of the alternate high-speed terrestrial technologies becomes available in a particular community.

In fact, satellite delivery of broadband services may well be the technology of choice for many rural areas. Although at present the uplink is typically accomplished by conventional telephone service, that infrastructure and customer base is already in place and ubiquitously deployed. For the price of a small satellite dish coupled with the customer's *existing* telephone line, broadband access to the Internet can be offered almost anywhere within the satellite's geographic footprint literally within a few days after the "bird" is launched with virtually no terrestrial infrastructure upgrades. While the capacity of the uplink will be constrained by the limits of a voice-grade dial tone access line, downloads from the satellite at speeds of up to 400 Kbps are available to consumers today.[62]

The uplink-via-telephone limitation is being addressed by several companies, including Hughes, Loral, and Lockheed Martin.[63] According to the FCC, over $20-billion has been invested in the space telecom industry since 1993, much of which has gone to fund broadband satellite telecommunications development.[64] Firms currently offering or planning to offer broadband service over satellite systems include:

- *Hughes DirecPC* offers satellite service nationwide at download speeds of up to 400 Kbps; upload speeds are limited to 33 Kbps via normal dial-up modem service. DirecPC charges $200 for a satellite dish with installation, and $50 monthly for unlimited Internet access.[65] Recently, the major Internet services provider America Online (AOL) announced that it has invested $1.5-billion in DirecPC and will offer Internet access via the DirecPC satellite network to its customers by early 2000.[66]

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62. "The Faster Web," *PC Magazine*, April 20, 1999, p. 163.

63. The first LEO system to become operational, Iridium LLC, has suffered large financial losses and recently filed for Chapter 11 bankruptcy protection. However, analysts have suggested that Iridium's problems stem from a number of failures in execution, including flawed marketing and organizational strategies, rather than any inherent problems with LEO technology, and other LEO systems are moving ahead with deployment. Iridium had developed a narrowband voice application, and was not engaged in the broadband data market. See "Iridium Defaults on Loans, Files for Bankruptcy; ICO Doesn't Get Financing, As Globalstar Plunges Ahead," *Telecommunications Reports*, August 16, 1999, at 5; "Iridium's Downfall: The Marketing Took a Backseat to Science", *Wall Street Journal*, August 18, 1999, at A1.

64. FCC Report in the Section 706 Proceeding, at para. 39.

65. O'Donnell, Mathew, "High-Speed Internet Access: Broadband in the Boonies," *Home Office Computing*, August, 1999, Vol. 17, No. 8, p. 17.

66. AOL Press Release, "America Online and Hughes Electronics Form Strategic Alliance to Market Unparalleled Digital Entertainment and Internet Services," June 21, 1999.

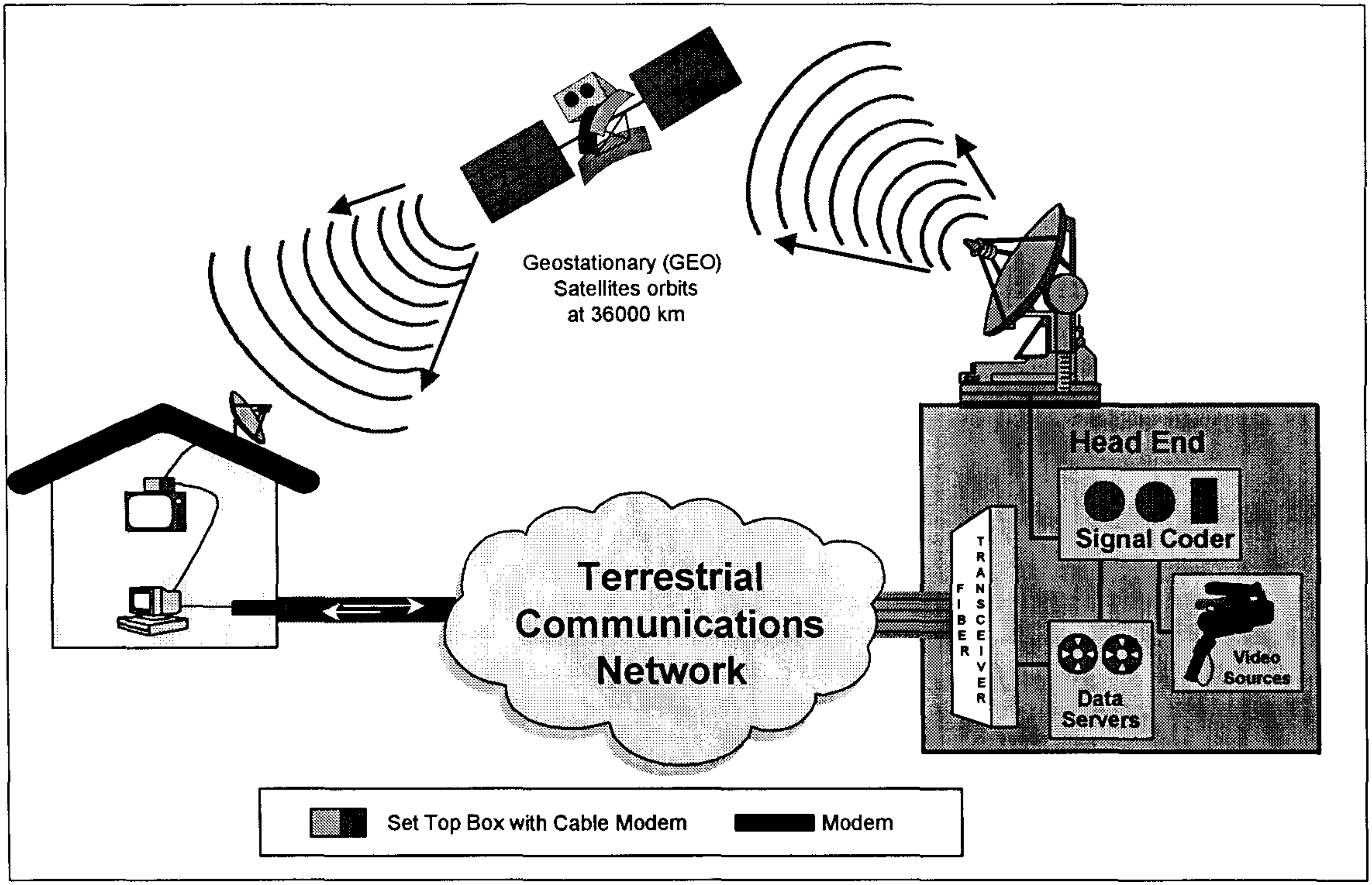

Figure 5. Satellite Internet service configuration.

- *Hughes* is also currently developing a "next-generation satellite system for two-way, broadband connectivity, known as Spaceway™," which is scheduled to launch in 2002.[67] Hughes has previously announced that it will invest $1.4-billion to design, manufacture and launch this network.

- *PSINet* is "actively exploring satellite and wireless delivery mechanisms for broadband delivery in rural and other unserved areas,"[68] either directly to the customer or "as a way for ISPs serving rural areas and other high-cost areas to connect to PSINet's backbone at high speeds."[69]

- *Skybridge* is developing satellite broadband systems and states that "new satellite technologies such as SkyBridge can provide ... the availability of broadband tele-communications to literally everyone."[70]

- *Loral's CyberStar* unit is in the process of developing a satellite-based broadband communications network. Its mission is "to provide broadband communication and information services by combining satellite technology with land-based networks to enable new applications that simply are not possible using conventional network technologies alone."[71]

- *Astrolink*, a joint venture of Lockheed Martin, TRW and the Telecom Italia Group, has plans to launch four geostationary satellites that will allow "high-quality, two-way broadband communications."[72]

- *Teledesic* recently signed a launch contract with Lockheed Martin and an agreement with Motorola to build the terrestrial elements of its network.[73] Using Teledesic's broadband service, "most users will have two-way connections that provide up to 64

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67. See http://www.direcpc.com/consumer/scoop/pr11.html.

68. Comments of PSINet, Inc. in the Section 706 Proceeding, at 2.

69. *Id.*, at 8.

70. Comments of Skybridge in the Section 706 Proceeding, at 4.

71. See http://www.cyberstar.com/cu2_fs.html.

72. See http://www.astrolink.com/pages/english/framesets/cap/cap_set.html.

73. See http://www.teledesic.com/newsroom/7-9-99.htm.

Mbps on the downlink and up to 2 Mbps on the uplink." Teledesic is also developing broadband terminals that will provide two-way speeds at 64 Mbps.[74]

Once operational, these two-way satellite-based services will eliminate the need for the telephone uplink while offering the same or better functionality than is currently available from terrestrial two-way high-speed Internet services.

Table 6

Advantages and Disadvantages of Satellite Broadband Service

Advantages	Disadvantages
LEO systems are "location insensitive," i.e., can reach anywhere in the world;	Highest up-front fixed costs of all the technologies; and
Telephone service, required (at this time) for the uplink, are ubiquitously deployed and readily available to users; and	Two-way broadband satellite systems are several years away from being operational.
Very fast download speeds.	
One-way (downlink) broadband satellites are operational today.	

Terrestrial fixed wireless technology

Wireless (voice) telephony has developed to a point where there are in the US nearly half as many wireless telephones as there are phones tethered to the public wireline network.[75] But this has not been the case with broadband services — until now. Advan-

74. See http://www.teledesic.com/tech/details.html.

75. As of year-end 1998, there were some 69.2-million wireless telephone subscribers in the U.S., compared to 169.2-million wireline telephones (as measured by switched access lines). See FCC 99-136, *Fourth Report*, released June 24, 1999, at Appendix B, Table 5; and FCC *Preliminary Statistics of Communications Common Carriers, 1998 edition*, released May 28, 1999, at Table 2.4.

ces in digital systems have substantially increased the capability and capacity of fixed wireless networks, making wireless one of the most promising long-term solutions to broadband connectivity — particularly in sparsely populated rural areas.

Some industry groups see wireless as "the most efficient and economical bridge for the 'last mile.'"[76] Wireless services offer the advantage of significantly reduced infrastructure requirements – relative to fixed fiber or copper – thus making it especially attractive for use in (non-mountainous) rural areas where good line-of-sight signal propagation is possible. Indeed, where there is no wireline or wireless infrastructure in place at all (as, for example, in many developing countries), fixed wireless access to the public telephone network can often be provided at considerably lower cost and almost always more rapidly than where massive wire infrastructure builds would be needed.

Table 7
Advantages and Disadvantages of Wireless Broadband Service

Advantages	Disadvantages
Low deployment and installation costs (on a per-subscriber basis); Can be quickly brought to market; Scalability of the operation in response to varying demand levels; and Minimal incremental infrastructure requirements.	Signal propagation limitations, line-of-sight requirements may limit terrestrial wireless services to relatively flat terrains (e.g., the Mid-west and Plains, but not in the Rockies or in Appalachia); and Problem of "rain fade" and other transmission limitations may reduce the reliability of microwave-based relative to wireline services.

There are at present two different broadband wireless standards, Multichannel Multipoint Distribution Services (MMDS) and Local Multipoint Distribution Services (LMDS), each of which is being installed by various carriers across the country.

Multichannel Multipoint Distribution Service (MMDS), which first became available in the early 1980s, uses relatively low power microwave frequencies to transmit over-the-air

76. See http://www.wcai.com/fixed_wireless.htm.

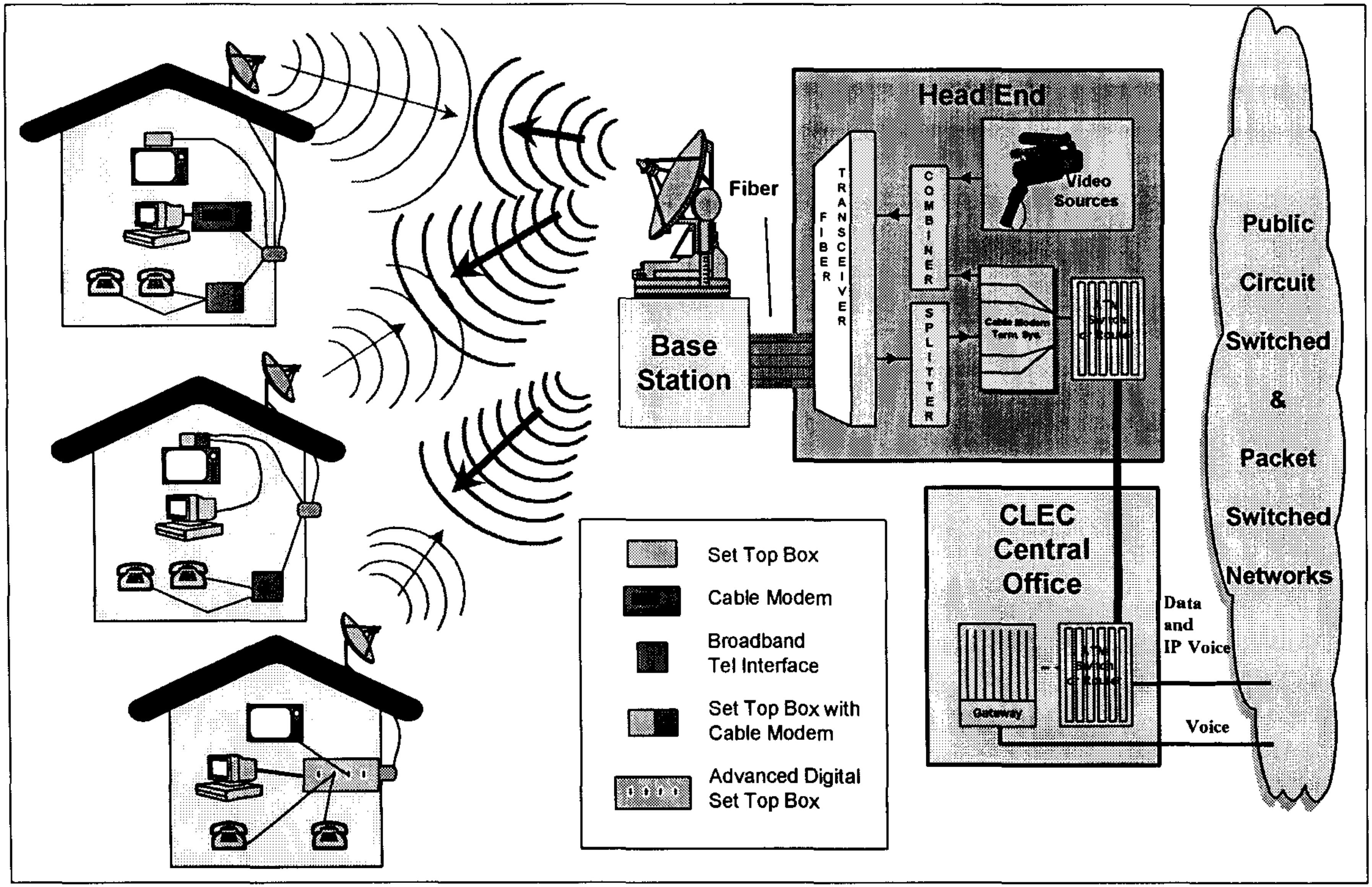

Figure 6. Wireless Internet service configuration.

television programming to subscribers.[77] MMDS offers a less capital-intensive alternative to fixed cable television systems and is more economic to construct, particularly in areas with low cable penetration rates.[78] MMDS operators have for a number of years been offering data services, with a wireless downstream and telephony upstream path.[79] MMDS systems have historically provided only one-way communications, but this was due to a regulatory restriction, not a technological limitation. In September 1998, the FCC lifted this restriction and now allows MMDS carriers to offer two-way communications, making this technology a viable entrant into the broadband arena.

Local Multipoint Distribution Service (LMDS), which operates in the 28 GHz to 31 GHz frequency band, was developed originally for (fixed) wireless local loop (WLL) applications, but has been used to distribute cable television signals, and today is being deployed as a two-way broadband solution. LMDS offers sufficient bandwidth to carry two-way video, high-speed data, and traditional telephone service simultaneously.[80] Because of its low cost structure and broadband potential, LMDS is expected in the future to link "corporate campuses to the enterprise network at speeds rivaling those now offered by fiber optic networks."[81]

Earlier this year, the FCC completed its LMDS spectrum auctions. Licenses covering 483 markets were sold for a total of $625-million.[82] 29 independent telephone companies or alliances serving rural areas won 85 licenses. US West was the only incumbent carrier among the top 10 bidders, implying that the companies that are building LMDS networks are primarily new, innovative, entrepreneurial firms. For example:

77. Wireless Communications Association, "Fixed Wireless Broadband: An Introduction," Available at http://www.wcai.com.

78. C.E. Unterberg, at 31.

79. Wireless Communications Association, "Fixed Wireless Broadband: An Introduction," Available at http://www.wcai.com.

80. Richter, Skip, "Diving into LMDS," *Rural Telecommunication*, July, 1999. Available at http://www.ntca.org/pubs/rtonline/rt_july99/story3.html.

81. C.E. Unterberg, at 31.

82. For information on the LMDS auction, see the FCC Wireless Telecommunications Bureau at http://www.fcc.gov/wtb/auctions/lmds/lmdstxt.html.

- *WNP Communications* won 40 LMDS licenses for which it paid $187-million.[83] The licenses cover most of the eastern US, from Maine through Georgia and as far west as Texas and Missouri, and California. [84]

- *WinStar LMDS* uses an entirely wireless network to provide business customers with local, long-distance and information services. WinStar paid $43-million for 15 LMDS licenses in last year's spectrum auction.[85] Eight of these licenses cover top US markets, including: Oakland, San Francisco, Norfolk, San Jose, Orlando, New Orleans, Salt Lake City and Greensboro. These new holdings, when combined with WinStar's previous wireless facilities, provide a national wireless footprint.[86]

- *Cortelyou Communications* paid $25-million for 13 licenses, all of which are located in Ohio. Cortelyou is pursuing a state-specific strategy rather than a national or super-regional footprint favored by other large LMDS license holders.

- *Baker Creek Communications* holds 232 LMDS licenses for which it paid $25-million. The licenses cover most of the eastern seaboard and selected communities in Oregon.[87]

Nextlink Communications, which was founded by wireless telecommunications pioneer Craig McCaw in 1994 to deliver next-generation communications services, recently purchased the LMDS spectrum licenses of WNP Communications and Nextband Communications for $542-million and $138-million, respectively, and is now one of the largest holders of fixed wireless spectrum licenses in the United States.[88]

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83. See http://www.fcc.gov/wtb/auctions.

84. See http://news.wirelessdesignonline.com/companies-in-news/19981027-931.html.

85. *Id.*

86. See http://www.winstar.com.

87. See http://www.fcc/gov/wtb/auctions.

88. Pappalardo, Denise, "10 Companies to Watch: Nextlink puts money down on LMDS," *Network World 2000,* April 26, 1999. Available at http://www.nextlink.net/ra/news/archive/news/networld/index.html.

Wireless broadband is expected to "hit its stride" in the next few years.[89] Although the many license winners are only beginning to build out their networks, LMDS is currently being trialed by one RBOC, and two rural carriers expect to be providing service by the end of the year:

- *Bell Atlantic* is pursuing LMDS as a broadband solution for its outlying subscribers and is currently testing a WLL application with 100 rural customers in Brainardsville, New York.[90] Bell Atlantic's system uses a fixed-to-multipoint distribution system and has a signal range radius of 7.5 miles, giving the system coverage of over 176 square miles.

- *Central Texas Telephone Cooperative*, located in Goldthwaite, Texas, covers over 3,300 square miles, and serves 7,000 access lines, holds both the A- and B-block licenses for the two Basic Trading Areas that cover its service territory, and will offer LMDS service by the end of 1999.[91]

- *South Central Telephone*, in Medicine Lodge, Kansas, was interested in LMDS as far back as 1997. South Central won the LMDS license for Wichita and will enter that market as a CLEC offering wireless broadband services.[92]

Among small ILECs, South Central and Central Texas are leading the pack for rural LMDS deployment, with many other carriers following closely behind. A number of rural telcos acquired LMDS licenses in last year's auctions and should start rolling out service in the coming months. These carriers see LMDS as offering the entire suite of broadband services with relatively low fixed costs, making it an ideal technology for rural areas. According to the National Telephone Cooperative Association, "[w]hether they are diving right in or taking a more cautious route, rural companies are going to feel the effects of LMDS."[93]

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89. "The Faster Web," *PC Magazine*, April 20, 1999, p. 161.

90. "Bell Atlantic Tests Wireless Local Loop in Rural New York," *Communications Daily Washington Newswire*, June 23, 1999.

91. Richter, Skip, "Diving into LMDS," *Rural Telecommunication*, July, 1999. Available at http://www.ntca.org/pubs/rtonline/rt_july99/story3.html.

92. *Id.*

93. *Id.*

Electric Utilities and Broadband Service

A particularly promising entry into the rural broadband deployment race comes from electric distribution utilities. Like incumbent local phone companies, electric utilities also possess ubiquitous distribution infrastructures within their franchise areas. They own, either outright or in partnership with the ILEC, pole lines and other infrastructure elements that can support the rapid and economical deployment of fiber optics or other telecommunications distribution media throughout their service areas. And recent technological breakthroughs raise the possibility of utilizing the *existing* electricity distribution plant to carry telecom signals to individual customer premises.[94]

In southeastern Colorado, a government/private partnership is fine tuning a 630 mile fiber optic network called the *Arkansas Valley Technology Project* that links 80 "schools, libraries, hospitals and other public institutions in the lower Arkansas Valley."[95] The loop in this project, which consists of fiber optic cable deployed along the utility's electric poles, spans nine counties covering an area of 13,500 square miles and connects 23 towns.

A similar project is being considered by the Eugene, Oregon Water and Electric Board, which hopes to develop a high-speed broadband network by placing fiber optic cables along the utility's poles and rights-of-ways.[96] Two pilot projects are planned, linking 50 to 100 homes and schools in Eugene to this broadband network.[97] The total cost of this project is expected to be around $70-million, but the bulk of the cost is building the link from the network to the homes, which will be accomplished either with fiber or hybrid fiber/coax cable.

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94. There are, for example, companies such as Media Fusion that are moving towards providing voice, video and Internet services using the existing electric power grid and available "to anyone with an electrical outlet." For more on Media Fusion, see: http://www.mediafusionllc.net/northamerica/main/summary/index.html.

95. Fillion, Roger, The Denver Post, "High-Speed access spreads to southeastern Colorado," June 21, 1999. Available at http://www.denverpost.com/business/biz0621a.htm.

96. See http://eweb.org/innovations/telecom/glance.html.

97. *Id.*

Conclusion

With billions of dollars already having been spent or currently earmarked for investment in wireless and satellite broadband telecommunications, it is clear that these solutions for rural broadband service delivery are on-stream and in the market *today*, and that their potential reach is geographically extensive. Together with terrestrial cable and DSL distribution infrastructures, wireless technologies can be relied upon not only to offer services in rural communities, but to bring *competition* for these services to communities in all parts of the country.

5 PROSPECTS FOR RURAL BROADBAND DEPLOYMENT

A wide array of broadband services delivered over a variety of technologies is now in the offing, and these services are already available in many parts of the country. Moreover, additional infusion of capital and deployment of infrastructure to provide advanced telecommunications services is actively underway by large and small ILECs, competitive local telephone carriers, cable companies, energy utilities, wireless providers, and satellite companies. While the big incumbent LECs have concentrated their efforts on the relatively straightforward and low-cost upgrades to urban and suburban distribution networks to accommodate the introduction of ADSL as their "high-speed Internet" entry, small ILECs and cable, wireless and satellite operators have been concentrating on broadband deployment in precisely those communities that the ILECs have largely ignored.

To be sure, technological advances are working to make it possible to provide DSL services in low-density areas where the distances between the wire center and the customer are relatively large. These developments are making it possible for ILECs and CLECs to extend their ADSL offerings into areas well beyond the original 18,000-foot distance limit. But technologies other than DSL may also be well-suited to serving rural communities. Cable television distribution networks — which were built up in rural areas even before they arrived in the cities and suburbs — are rapidly being upgraded with fiber optic feeder links connecting cable "head-ends" with "remote terminals" miles away so that two-way high-speed Internet access can be supported. Several companies specializing in furnishing cable-based Internet access are offering "turn-key" packages to even the smallest, most remote "mom-and-pop" cable systems so that even the most geographically isolated communities can have the same high-speed, high-quality access to the Internet as is being provided in large metropolitan areas. High-bandwidth satellites now permit these remote, rural systems to achieve full-function connectivity to the Internet backbone even where terrestrial backbone access is not readily available.

Rural customers are beginning to enjoy a level of technological choice, comparable to that being offered to their urban counterparts. Direct broadcast satellite systems have become major players in providing Internet access in rural areas, and as their data-handling capacity increases, will be fully competitive with terrestrial broadband distribution systems in offering high-speed Internet access to end users. High-speed Internet access via satellite is available *today* to rural households across the country. While they require the use of conventional dial-up telephone lines for the uplink, that condition will change in the next few years. Other terrestrial wireless technologies are also being deployed in rural areas, which offer the double opportunity for development of these services due to the relatively less congested electromagnetic spectrum (in comparison with urbanized areas) and the substantially higher cost of constructing terrestrial wire/cable/fiber-based distribution networks.

Clearly, rural communities and their residents are *not* becoming the orphans of the information age, but are full-blown participants with access to the same services and capabilities — and at roughly the same costs — as their urban cousins.

At least with respect to the Internet and the availability of broadband access, the *Telecommunications Act of 1996* is doing exactly what Congress had intended. It has stimulated massive investment of capital and other resources and has brought feature-rich Internet access to all parts of the country. It has opened the market both to competing providers and to competing technologies. And it is done all of this while maintaining relatively low and highly affordable prices to the end user.

To be sure, there are a number of economic questions that still remain unresolved:

- Which of the competing technologies can be deployed more quickly in urban and/or rural areas?

- How does the relationship between initial fixed costs and per-subscription costs impact deployment and availability?

- Which of these technologies has the greatest potential for widescale competitive presence?

Fortunately, all of these questions can — *and will* — be answered *in the marketplace* provided that the marketplace is permitted to operate properly. Firms prepared to invest at-risk capital should be afforded the ability to fully develop and exploit the fruits of those initiatives. Incumbent local telephone companies should comply with the Telecom Act's requirement that they fully open their networks, whose construction and acquisition was accomplished — and underwritten by consumers — under a protected monopoly franchise, so as to facilitate entry by others while at the same time limiting the incumbents' ability to engage in anti-competitive behavior designed to block or otherwise frustrate entry by rival firms.

Regulators and policymakers must work to create an environment in which wide-scale competition can flourish. The road to this competitive environment cannot include policies that favor particular companies or particular technologies. The current widespread availability of broadband service confirms that, contrary to RBOC claims, existing legislation and regulatory policy is working, and no diminution of the effectiveness of those policies is either required or appropriate at this time.

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